"On the Group IV Lines of Silicium."

By Sir Norman Lockyer, K.C.B., LL.D., Sc.D., F.R.S., and F. E. Baxandall, A.R.C.Sc.

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[Plates 11 and 12.]

In previous communications to the Royal Society* an account was given of the behaviour of the lines of silicium under varying experimental conditions, and as a result of this enquiry, the lines were divided into four distinctive groups.

In these papers no reproductions of the silicium spectra were given, a description of the behaviour of the lines in the various photographs being at the time considered sufficient.

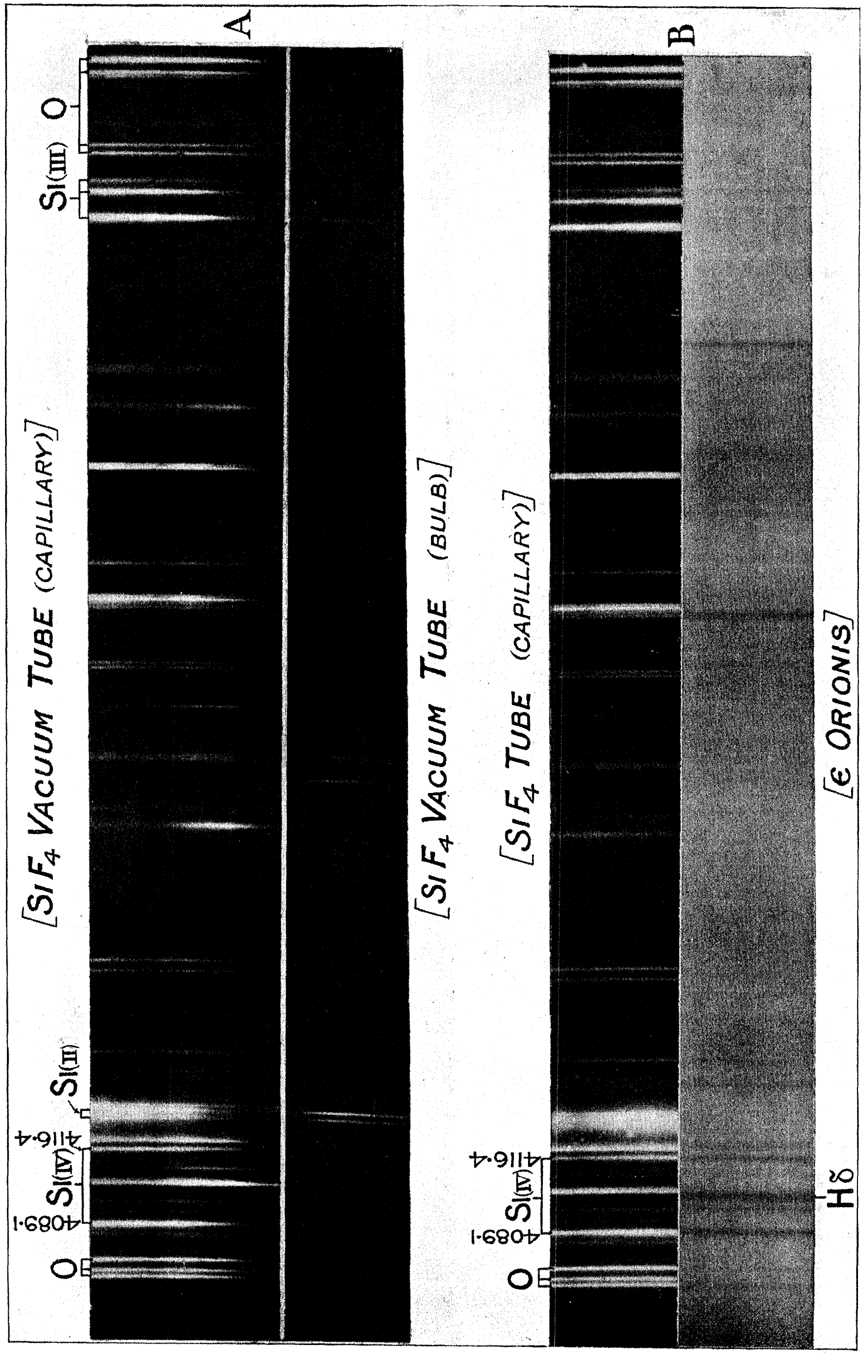
The genuineness of the lines of Group IV, as silicium lines, has recently been questioned by M. de Gramont. In his paper† he gives an account of the effect of self-induction on the various groups of lines into which the silicium spectrum was divided from a study of the Kensington photographs. He also gives an analysis of these lines with regard to their appearance in stellar spectra. He agrees as to Groups I, II, and III, but states that the lines of Group IV always disappear from his spectra with the air lines, and he concludes from this that they are not genuine lines of silicium, but belong to either oxygen or nitrogen. This conflicts so much with the conclusions arrived at from the investigations of the Kensington photographs that it becomes necessary to give the photographic evidence on which the lines were accepted as being due to silicium.

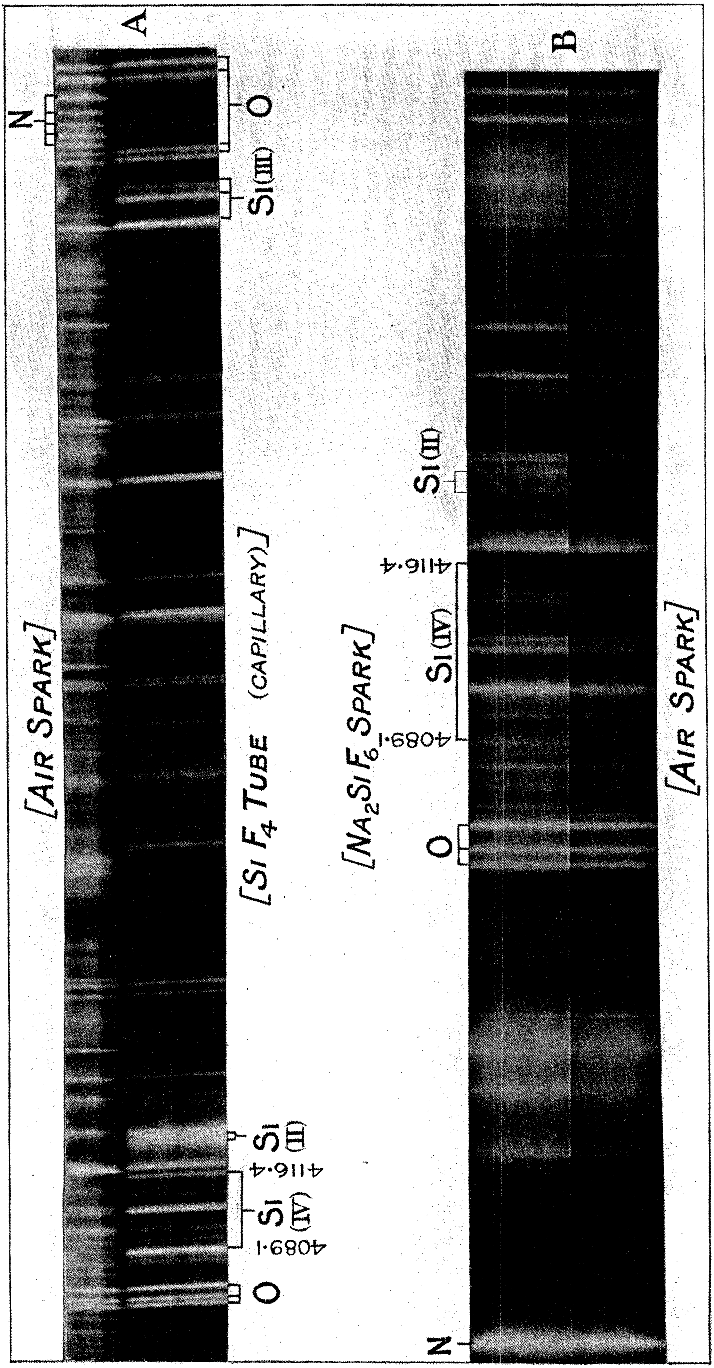
The wave-lengths of the lines of Group IV are 4089·1, 4096·9, and 4116·4. Of these three, 4096·9 is quite insignificant in intensity compared with the other two, and as it is so weak as not to be shown in the reproductions of the photographs, it may well be left out of the present discussion. It may here be stated that, according to Neovius, there is a weak and diffuse oxygen line (Intensity 1) at λ 4089·2, and a weak nitrogen line (Intensity <1) at λ 4116·7; which are very nearly the positions of the silicium lines. Whether these are the lines which M. de Gramont gets in his spectra—he records both in his lists as very faint—it is not possible to say, but that they are not the lines which appear in the Kensington photographs will probably be readily admitted when the reproductions of the spectra in the present paper are carefully examined.

The spectrum A shown in Plate 11 is that given by an electric discharge in a vacuum tube containing silicium tetra-fluoride. The bottom portion is that from the incandescent gases in the bulb of the

* 'Roy. Soc. Proc.,' vol. 65, p. 449; vol. 67, p. 403.

† 'Comptes Rendus,' vol. 139, p. 188.


A
B
O
Si(III)
Si(II)
4116·4
Si(IV)
4089·1
[Si F4 VACUUM TUBE (CAPILLARY)]
[Si F4 VACUUM TUBE (BULB)]
[Si F4 TUBE (CAPILLARY)]
[ε ORIONIS]
Hδ


A
B
[Air Spark]
N
O
Si (III)
[Si F4 Tube (Capillary)]
Si (II)
4116·4
Si (IV)
4089·1
O
[Na2 Si F6 Spark]
Si (II)
4116·4
Si (IV)
4089·1
O
N
[Air Spark]

tube, the top that from the capillary, both photographed during the same exposure. The transverse white line represents the junction of the spectra of the bulb and capillary. In the top portion the silicium lines of Groups II, III, and IV, are well seen, and also the ordinary lines of oxygen, these being indicated in the reproduction. The triplet marked O is one of the most conspicuous features of the spark spectrum of oxygen, and the individual lines are, according to Neovius, the strongest in the oxygen spectrum. It will be seen that the Si IV line 4089·1 is stronger than any of the oxygen triplet lines, while the line 4116·1 is about as strong as the latter. As the oxygen and nitrogen lines of Neovius which occur near these lines are of intensity (1) and (<1) respectively, it is evident that if the lines ascribed to Si IV in the Kensington spectra are really due to air, as M. de Gramont contends, they must undergo a remarkable transformation as regards intensity in passing from the conditions of the ordinary spark spectrum to those of the vacuum tube. There is, however, no indication of the selective enhancement of these faint air lines in the Kensington spectra of air under the vacuum tube conditions.

It will be instructive to trace the behaviour of these different sets of lines in the two portions of the spectrum shown in Plate 11. It will be noticed that in the bottom or bulb portion of the spectrum the oxygen triplet survives, though it is very weak. The Si IV lines, however, one of which is stronger in the top spectrum than the oxygen lines, have entirely disappeared. As to the silicium lines of Groups II and III, they are represented in the bulb spectrum; both sets, however, being weaker than in the capillary spectrum, the weakening in intensity being more marked in the case of Group III than Group II. It is thus seen that the conditions appertaining to the gases in the bulb are conducive to the existence of the lines of Group II; less so to those of Group III; and not at all to those of Group IV.

In B of Plate 11 the Si F_4 spectrum is reproduced alongside that of ϵ Orionis. The identity of position of the oxygen triplet and Si IV lines with lines in the stellar spectrum is there denoted. It may here be stated that the stellar and terrestrial spectra do not exactly fit throughout their whole length, owing to the fact that they were obtained with different prisms.

In A of Plate 12 the spectrum shown in the top part of A Plate 11 is compared with the ordinary spark spectrum of air. The lines 4089·1 and 4116·4 of Si IV, which are strongly marked in the vacuum tube spectrum, are entirely lacking in the air spectrum, although the oxygen triplet previously referred to is common to both spectra and of about equal intensity in each.

In B of Plate 12 the spark spectrum of sodium silico-fluoride, volatilised between platinum poles, is compared with the spectrum of air, also made incandescent between platinum poles. In each

spectrum the ordinary lines of oxygen and nitrogen are well seen. The silicium lines 4089·1 and 4116·4, denoted in the reproduction, are shown in the top spectrum, but they are entirely lacking in the air spectrum at the bottom. It would be remarkable that these lines, if really due to air, should not appear in the air spectrum itself. Moreover, the lines do not appear in the spark spectra of any of the chemical elements investigated other than silicium, although in all these the ordinary air lines are always well shown.

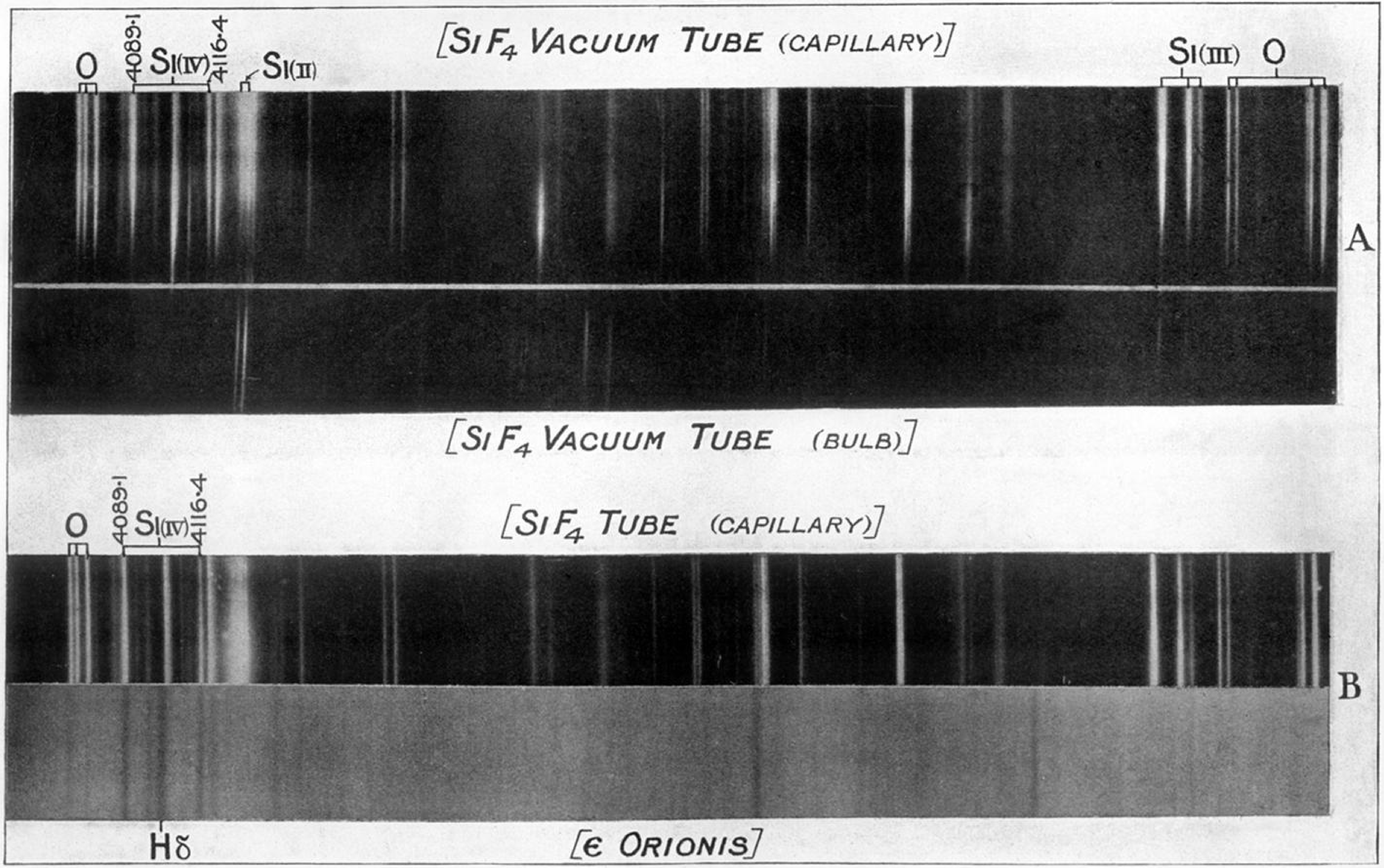
To sum up, the lines of Group IV have never been noted in any Kensington spectra without being accompanied by silicium lines of other groups, and they never appear unless silicium in some form or other is used in the light source furnishing the spectrum.

With regard to their identity with stellar lines, whatever their true terrestrial origin may be, there is scarcely any doubt. They agree exactly in wave-length with very strong lines in the spectra of the belt stars of Orion, and with less conspicuous lines in many other stellar spectra, for which no other satisfactory origin has been suggested.

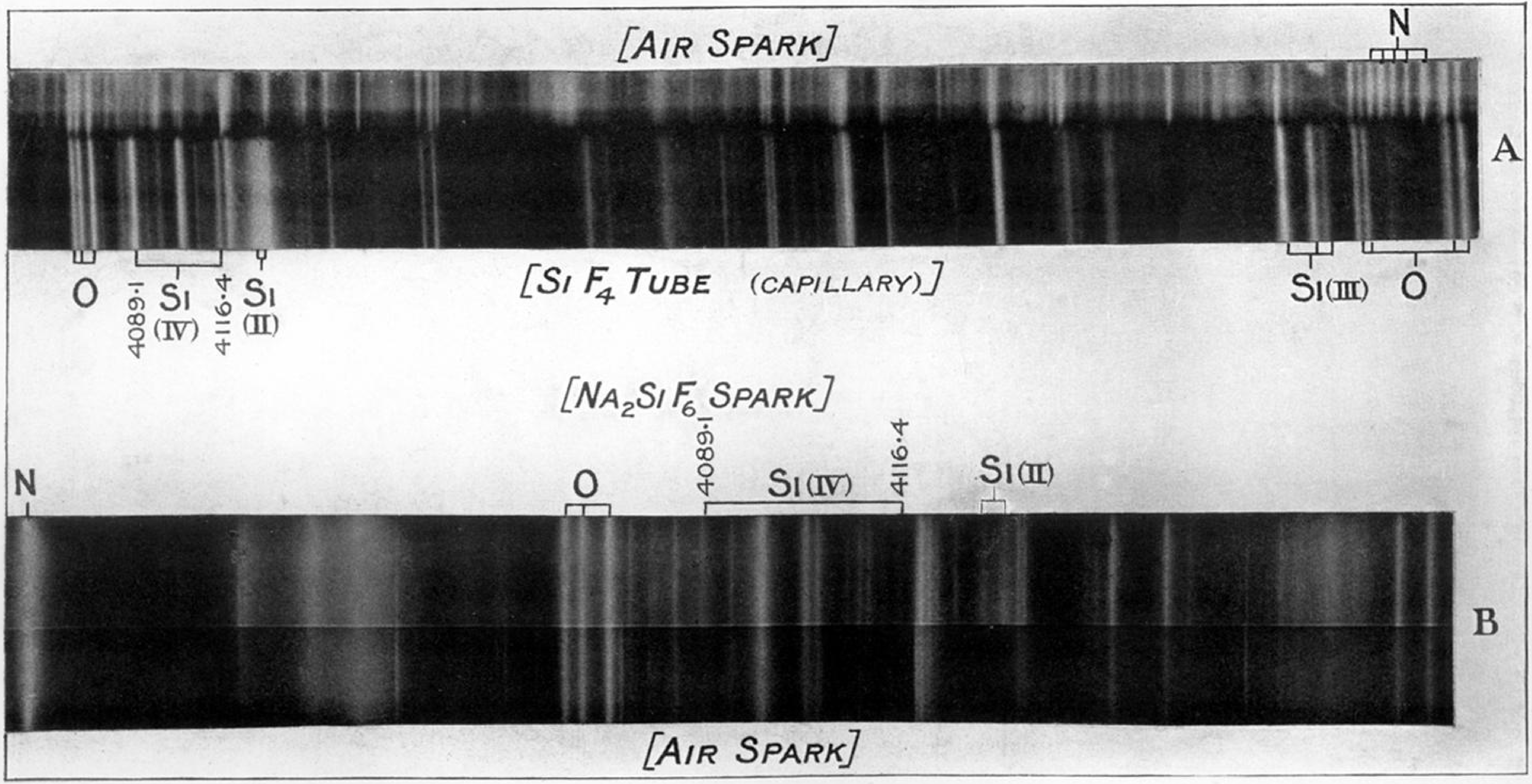
"On Chemical Combination and Toxic Action as exemplified in Hæmolytic Sera."* By Robert Muir, M.D., Professor of Pathology, University of Glasgow, and Carl H. Browning, M.B., Ch.B., Carnegie Research Fellow, University of Glasgow. Communicated by Dr. C. J. Martin, F.R.S. Received November 10,—Read December 1, 1904.

It is now well known that the action of a hæmolytic serum depends upon two substances, viz.: (*a*) the immune-body, which is developed as the result of the injection of the red corpuscles of an animal of different species, and (*b*) the complement, a labile substance which is present in the serum of the normal animal, and which is not increased as the result of such injection. Ehrlich has pointed out the similarity in the constitution of complements and of various toxins, and our own observations strongly support his views. We may, in the study of hæmolysis, consider the complement as a toxin, the red corpuscles treated with the appropriate immune-body as the object on which the toxin is to act, and the hæmolysis as the indication of the toxic action. Ehrlich regards the complement as consisting of two chief atom-groups, the haptophore or combining group and the zymotoxic; but in speaking of the action of sera he does not always carry out this distinction completely. For example, the efficiency of different complements as tested by their hæmolytic or bacteriolytic effects is often taken as

* The expenses of this research were defrayed by a grant from the Carnegie Trustees.



[Si F4 Vacuum Tube (capillary)]
O
4089·1
Si(IV)
4116·4
Si(II)
Si(III)
O
A
[Si F4 Vacuum Tube (bulb)]
O
4089·1
Si(IV)
4116·4
[Si F4 Tube (capillary)]
B
Hδ
[ε Orionis]


[AIR SPARK]
N
A
O
4089·1
SI
(IV)
4116·4
SI
(II)
[SI F_4 TUBE (CAPILLARY)]
SI(III)
O
[NA_2SIF_6 SPARK]
N
O
4089·1
SI(IV)
4116·4
SI(II)
B
[AIR SPARK]